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ART. VIII.—*United States Exploring Expedition.*—

1. *The Zoöphytes*; by JAMES D. DANA, A. M., Geologist of the Expedition. 1846. Large 4to. pp. 740. With an Atlas of 61 plates in folio.
2. *Ethnography and Philology*; by HORATIO HALE, A. M., Philologist of the Expedition. 1846. Large 4to. pp. 666.

WE duly noticed the Narrative of our national Exploring Expedition, published by its indefatigable commander. Those interesting, though diffuse, volumes comprise a full account of the details and incidents of the voyage, and afford the reader a general idea of the work performed and the results attained. But the permanently valuable results of this great undertaking, by which its success is ultimately to be measured, are embodied in the scientific reports now in course of publication. Foremost in importance among these, doubtless, is the hydrographical portion, of which, however, it is not our purpose now to speak, except to say that the charts and surveys which have already appeared are pronounced by competent judges to be of unrivalled excellence, and to reflect the highest credit on the commander and his subordinate officers, who have so faithfully executed the arduous duties of this department.

Besides these charts, the only volumes yet published are the two the titles of which stand at the head of this article. These are the first fruits of the rich scientific harvest which our zealous *savans* have gathered. Before we open them, we are bound to call public attention to a serious error in respect to the mode, or rather the amount, of publication, which, unless corrected in season, must render them forbidden fruit to nearly all the scientific world. We know something of the interest with which the appearance of these volumes is awaited, not only by the comparatively few laborers who represent the rising science of our own land, but especially by their numerous European brethren. Let our readers imagine their surprise and our mortification, when they learn that the edition ordered by the “collective wisdom of the nation,” or the more concentrated intelligence of the library committee of Congress, which has charge of the subject, is restricted to *one hundred copies!* It would

be hard to contrive a more effectual plan for defeating the very object of publication. When it is considered, that much the larger part of this five score of copies will probably be absorbed in presents to foreign cabinets and to the State governments, it will be evident that few indeed are likely to be accessible to those who can really appreciate or profit by them. Such niggardly publication is only tantalizing the votaries of science. It is, moreover, particularly unjust to the authors of these works, who, after devoting four of the best years of their lives to severe labor, exposed to danger and every privation, and as many more, since their return, to the elaboration of their materials,—confident that they have been able to make no meagre additions to the general stock of knowledge, and to lay a broad foundation for their own scientific fame,—have surely a right to expect a fair hearing before the scientific world.

This infinitesimal edition can hardly have been ordered, one would think, on the score of economy. If so, the penny-wise system begins too late; for all the principal expenditures have been lavishly made. We refer not so much to the Expedition itself, upon which hundreds of thousands have been cheerfully expended, nor to the preparation of the scientific reports, of the drawings, &c., upon which a full corps of *savans* and artists have been so long engaged, as to the actual cost of publication, the whole expense of type-setting and engraving having been equally incurred for this small number of copies. The additional charges of an ample impression would be merely the trifling cost of paper and presswork, and, in some cases, of the coloring of plates. This beggarly plan, therefore, has not even the poor merit of parsimony. Under these circumstances, if not an oversight, it is sheer extravagance,—an epithet strictly applicable to this “withholding more than is meet,” when it renders former liberality unavailing. We shall be among the last to find fault with these beautiful volumes, printed on fine paper, with the utmost luxury of type and amplitude of margin. Still, if it be a question between an edition of a hundred splendid but inaccessible copies, and an adequate one in a cheaper form, surely no reasonable person, not even Congress, “can long debate which of the two to choose.” But no change is necessary in this respect, except the ordering of an additional impression of three

hundred or five hundred copies, to be placed on sale, — just as the charts of the Expedition are sold, — at a price which will barely reimburse the additional cost. We are confident that this number of copies, sufficient to give the work needful circulation, would be promptly bought, even in the present somewhat expensive dress.* Some such plan has, we believe, been recommended to the consideration of the library committee of Congress by the leading scientific societies of the country, — with what success we have not yet learned. We can only add our protest against the present ill-advised scheme, which is preposterous on the score of economy, since nothing whatever is saved by it, and which, if persevered in, will be truly disgraceful to the country.†

It has occurred to us, as we turned the leaves of these sumptuous volumes, — though we like not to entertain the thought, — that a pitiful pride may have had something to do in limiting the number of copies, so as designedly to give them the adventitious value of great rarity ; that the library committee may have wished to imitate the equivocal patronage to science of some sovereigns, such as an emperor of Austria in the last century, for instance, who caused the works of Jacquin to be published in magnificent style, but in a very small number of copies, chiefly for distribution as presents, and then destroyed the plates, that imperial gifts might not subsequently be cheapened.

“These are imperial arts, and worthy kings,”

perhaps, in a former age, — though even royal patrons have now grown wiser ; but they are quite unworthy of republican imitation.

* We would by no means recommend Congress to follow the “pound-foolish” system which the State of New York has acted on, in the publication of the results of her noble and thorough Geological Survey. After expending hundreds of thousands of dollars upon the publication alone of a very large edition, at an unreasonable cost, and wasting, it would seem, a considerable amount in high prices for quite inferior typography, engraving, binding, &c., the job is crowned by the indiscriminate distribution of these large and costly volumes, many of them filled with recondite science quite unintelligible to common persons, among the first applicants (citizens of the State) at the price of one dollar apiece ! — a sum less than one fourth part of the cost of merely coloring the plates which several of these volumes each contain.

† We learn that the printers have, in fact, at their own responsibility and risk, secured an impression of 150 copies of the two volumes already printed ; but, besides the want of any guaranty for the continuance through the series of this unauthorized impression, it is evident that their

The volumes before us, to which, leaving this unpleasant topic, we gladly return, do not need the undesirable advantage of scarcity to give them value. They can well afford to stand upon their intrinsic merit ; and if others of the series sustain the same high character, the whole will form by far the most important contribution which our country has yet made to natural science. We propose to give a cursory notice of both works, on this occasion ; although the two subjects, zoöphytes and men, stand at opposite extremities of the scale of being, and have little apparent connection. To begin with the zoöphytes, or coral-animals, will be most in accordance with the natural order of things ; since, if they were not the remote progenitors of the human species, as the Lamarckian hypothesis maintains, they were doubtless its predecessors, and have borne no inconsiderable part in the construction of many of the islands upon which reside the races whose national characteristics and languages form the subject of the ethnographical and philological volume.

The systematical part of Mr. Dana's work, necessarily drawn up in strictly scientific form, is of course too technical for our present aim. But the copious introductory chapters on the structure and economy of the zoöphytes, or plant-animals, abound in curious matter. Here our author shows us how the coral grove vegetates, and the tree of stone raises its rugged trunk and spreads its branches, covered with animate blossoms ; — how undoubted animals, adopting the laws of vegetable growth, imitate so perfectly not only the branching shrub, but the varied forms of land herbage, "as to have deceived even the philosopher until near a century since." Not only the tiny moss, the humble lichen, and the graceful fern, but also the gay flowers of the *parterre* have their counterparts in the submarine garden. There is the Sea-Anemone, one of those Actinias which are most appropriately called flower-animals, and which, in form and size, and some of them in brilliant coloring also, rival the Asters, Carnations, and Anemones of the land. There are the Tubipores and Alcyonia, which resemble clumps of pinks, and Melittæas and Gorgonias, forming clusters of tinted twigs or rushes, sometimes spreading free in the still water, sometimes curi-

too limited number, giving them the factitious value of rarity, no less than the risk which the printers assume, will probably cause these copies to be held at so high a price as to defeat, in a good degree, the principal object of publication.

ously entwined, as if by art, into fans and coral wicker-work. "The Madrepores are crowded around in turf-like clumps and miniature trees in bloom, or imitate spreading leaves and graceful vases filled with flowers; while Astræas build up among the shrubbery large domes, embellished with green and purple blossoms, studding the surface like gems." It is, in short, as if the shrubs and blossoms that overhang the shore were seen reflected from the wave in somewhat distorted, but only the more strangely beautiful, shapes; or as if, at the subsidence of the tropical islets, to which it has been supposed the coral reefs owe their existence, the diverse forms of land vegetation had merely to

"suffer a sea change
Into something rich and strange,"

to produce these singular representations of herb, tree, and flower.

The name of zoophytes, given to these ambiguous productions before their real nature was understood, is still most expressive of their peculiar character. They are *animals which grow like a plant*. This name, which our author retains, though it was discarded by Lamarck and many succeeding naturalists, has the convenience of being applicable to the whole compound structure, the coral-tree, sea-fan, or aggregate of whatever shape. When an individual animal is spoken of, it is termed a polyp. Striking as are these imitations of vegetable forms by zoophytes, yet this whole resemblance is entirely superficial. They vegetate, indeed, but they are not vegetables. Although the polyps of the coral fabric bud and sprout like a plant, they are veritable animals still, exhibiting all the essential characteristics of their race. For the genuine credentials of an animal are, not the faculty of locomotion, which is an incidental convenience rather than a necessity of animal life, nor the possession of a head or heart, one or both of which are frequently wanting, but (let the *gourmand* be thankful to science for the distinction) the possession of a mouth and a stomach. Now the coral-polyps not only have these all-important organs, the sole absolute marks of animality, but they have scarcely any thing else. They are animals *par excellence*, divested of all superfluities. The simple polyp consists of a cylindrical or oblong body, flattened at the end

occupied by the mouth, which opens directly into the interior cavity or stomach. The mouth is usually surrounded by a fringe of tentacles, which, in many species, in the Sea-Anemone for instance, spread in imitation of the petals of a flower. But these petals close at once upon any small animal that alights upon them, not merely detaining the victim, as do the irritable leaves of the Venus's Fly-trap, but promptly conveying it to the capacious maw, where it is digested at leisure. The polyps are not jelly-like in consistence, as is often stated ; their texture is commonly fleshy or quite firm, so that they are capable of exerting considerable force. Nor are they, for the most part, invisible animalcules. Some, indeed, are microscopic ; but many of the common sorts are half an inch in width ; others measure two or three inches, and some of the Actinias are even a foot and a half in diameter, when their disk is spread. Though by no means the minutest, they are among the simplest of animals ; for the Rotiferæ, and even the Polygastric Infusoria, appear to have a more complicated structure. Some of them move about freely in the water, their tentacles serving for locomotive as well as prehensile organs. But the greater number are firmly attached to the rocks, or some other convenient support, to which they cling with the tenacity of an office-holder, while they gorge themselves with such pickings as fall within their reach. Some polyps, such as the *Hydra*, it is well known, may be turned inside out, like the finger of a glove, — or as the pliant office-holder turns his coat when the *ins* and the *outs* change places, — and still feed and digest unconcernedly, and thrive and batten in all respects just as well as before.

Such is the simple zoöphyte. Some, even of the proper coral-polyps, remain in this independent, single state all their lives long, — are solitary individuals, like the *Actinia* or Sea-Anemone ; when their only resemblance to plants lies in the floral form which their spreading tentacles or rays simulate. From the separate polyp of this sort, there are all possible varieties and degrees of complexity, up to those living and branching masses in which hundreds of thousands of individuals are congregated and united. But the myriads which compose the coral-tree, or mass, however extensive, are all the progeny of a single polyp ancestor, in which the offspring for generation after generation remain connected

with the parent. How this is brought about, so that the simple zoöphyte becomes a united family, and in time a body corporate, may now be considered. Rightly to understand this, we must contemplate the various modes of reproduction in these simpler animals, — modes which appear to be the more varied and curious as we descend in the scale, — beginning with that peculiar operation, so characteristic of the very lowest races, in which the simple polyps “go halves” by what the physiologists term fissiparous reproduction. In this way division is made to accomplish the ordinary result of union. A solitary individual splits up into two, each having an equal claim to be considered the parent of the other, and each equally capable of further multiplication by this odd way of *pairing*. This is one of the methods by which the proper Infusoria multiply at such a rapid rate.

Among zoöphytes, if the *Hydra* does not propagate exactly after this fashion, it is capable of doing so with a little adventitious aid, as was shown by those well known experiments of Trembley, who kindly assisted nature by cutting full grown individuals in pieces, and amused himself by observing each portion become a perfect *Hydra*; — the tail end, in the course of two or three days, producing a head, and the head end completing itself posteriorly by a tail. In case of a three-fold division, not only will the tail produce a head and the head a tail, but a head will grow from one end of the middle section and a tail from the other, so that the animal is speedily completed in triplicate. Continuing his experiments, Trembley found that “two polyps may be made to change heads, for the head of one may be engrafted on the body of another”; and if the tail of one individual be placed in the mouth of another, the two heterogeneous extremities readily unite, so as to confound all our notions of personal identity. It cannot further surprise us that animals so indifferent whether they wear their own heads or their neighbours’ should be equally indifferent whether they have any heads at all. Our author accordingly informs us, that certain aggregate zoöphytes of the order Hydroidea cast their heads at pleasure, as a lobster does his shell, or a tree its leaves in autumn; new ones springing up again after a short interval, fresh and young, to supply the place of those which were effete or addled. Thus, in a *Tubularia*, Mr. Harvey observed, after he had kept his specimens two days, that they began to look unhealthy, and on

the third, "the heads were all thrown off and lay on the bottom of the vessel." After three days more, fresh water having been supplied, the polyps were again complete.

Reproduction by spontaneous fission, however, does not explain how the single polyp becomes an aggregate; but the next, the *gemmiparous*, mode does. The budding process is nearly as universal in zoophytes as in the vegetable kingdom. The simplest case of gemmiparous propagation in polyps scarcely differs essentially from that by spontaneous fission, except that the distinction between parent and offspring is manifest. Take the *Hydra*, for example; although it sometimes breeds ova, after a more decidedly animal fashion, yet, for the most part, the young simply pullulate from the side of the parent.

"A minute protuberance first begins to rise on the surface; it lengthens and becomes a rudimentary branchlet, with a tubular axis connecting with the tubular cavity of the parent; shortly one or more tentacles begin to appear at the summit of the forming branchlet, and soon the number is completed, and the young polyp is perfected. It remains for a while attached; but, when matured, the young leaves the parent to swim at large and give birth to other young. They breed rapidly, and frequently new shoots commence before the animal is detached from the parent; and occasionally sprout on sprout is thus added, till a small compound group is formed." — p. 24.

This is just the way, locomotion excepted, in which the plants multiply in a bed of tulips, and in which the common bulblet-bearing lily of our gardens produces its buds or bulbs above ground, which separate, as independent plantlets, as soon as they are formed. As in the herb or tree the bud or offspring which remains united with the parent stem forms a branch, so likewise the continued adhesion of the budding polyp-progeny to the parent, and the successive development in this way of new individuals that do not acquire complete independence, produce at length the branching zoophyte. Each coral-tree commenced from a single polyp, just as the oak from an acorn; the branching mass in either case has arisen from the development of buds for generation after generation in union with the parent stock. And just as the branch of the growing tree, having expanded its leaves, renders its filial contributions to the mother stem, so the young persistent polyp, still sharing the maternal nourishment,

"extends its arms, and begins its contributions to the body-coralline," as soon as its mouth and tentacles are formed.

"The first polyp with which the zoöphyte commences thus gives out a bud, and this another; and so a succession is formed, and the little stem is gradually lengthened; branchlets grow out, and the plume, or miniature tree, is finally completed. The whole may be the work of a few weeks or months, though they usually continue budding and growing for some years. Before the zoöphyte has reached its limits in size, the number of polyps sometimes becomes immensely large. In a single specimen of *Plumularia* collected by the author in the East Indies, there are about 12,000 polyps to each plumose branch; and, as the whole zoöphyte, three feet long, bears these plumes, on an average every half inch, on opposite sides, the whole number of polyps is not short of eight millions; all the offspring of a single germ, and produced by successive buddings." — p. 24.

"The several polyps in a compound zoöphyte eat and digest separately, and generally carry on as individuals the processes of reproduction and aëration; yet all aid in the growth of the common mass, though each contributes more especially to its own nutriment and the part immediately adjoining. Although their visceral cavities are distinct, there are numerous communications between those of adjoining polyps, and the fluids may pass more or less freely from one to the other. An injury to one part of a zoöphyte is felt by the polyps some distance around, but not always through the whole mass. On pressing the tip of a branch of a large *Alcyonium*, in the Feejees, there was an immediate contraction of every polyp through the whole zoöphyte, although extending to a breadth of four feet." — pp. 14, 15. •

The coral is, therefore, a body-corporate, or community, — not by any means constituted, however, on the democratic principle of the association of originally independent individuals for the promotion of common objects, but really formed on the patriarchal system, — an analogy which we commend to the notice of writers on the theory of government. It is a sort of natural Fourier association, inasmuch as the gatherings of each are shared by all, although here, just as in its analogue, it turns out on examination that each individual is "more especially" occupied in taking care of itself. The members of the community not only feed at a common table, as at a corporation dinner, but have, moreover, the inestimable advantage of a corporate digestion. There is, however, considerable diversity in this respect, the burden of digestion

being sometimes thrown upon the public, and sometimes borne by the individual. In many species, where the stomachs of the young polyps at first communicate freely with that of the parent, the opening is afterwards closed, and the younger members of the family are left to their own resources. In others, there is such free and open intercommunication, "that adjacent polyps have scarcely any thing but a mouth which can be said to be private property." The whole is, as it were, one manifold ramified stomach, fed by a million of mouths. This system is eminently favorable to density of population ; which in these commonwealths sometimes defies all reckoning. The estimated number in one of the minuter zoophytes has been mentioned in a former extract ; the subjoined paragraph gives an idea of the populousness of some of the larger, dome-shaped corals.

" Calculating the number of polyps that are united in a single *Astraea* dome, twelve feet in diameter, — each covering a square half inch, — we find it exceeding one hundred thousand ; and in a *Porites* of the same dimensions, in which the animals are under a line in breadth, the number exceeds five and a half millions ; there are here, consequently, five and a half millions of mouths and stomachs to a single zoophyte, contributing together to the growth of the mass, by eating, and growing, and budding." — p. 60.

All polyps do not form coral ; nor is there any difference in structure or well marked line of distinction to be drawn between those that produce it and those that do not. Some remain soft and fleshy throughout ; some acquire in their older portions the consistence of cartilage or horn ; others secrete a few scattered granules of lime ; and from these there are gradual transitions up to the proper coral-making species, whose secretions form a solid framework to the animal. Quite erroneous, too, is the common opinion, that the coral is a calcareous exudation from the surface of the polyps ; it is an internal secretion, analogous rather to the skeleton of a vertebrate than to the shell of a molluscous animal. It is not like a beehive, a collection of cells which the animals have built, and in which they live. On the contrary, the coral is contained within the body of the polyp, where it is generally concealed from view, or covered by the animal tissues, at least in the living part of the coral branch. The dead coral exhibits only the skeleton, or calcareous

framework, from which the flesh has disappeared. Certain species form coral only at their base or point of union. As the united polyps of a branch have their mouths opening outwards on every side, while their confluent bases are all directed inward towards a common central line, the secretion of coral by these bases necessarily produces a solid axis to the branch, which gradually indurates below as it grows from the apex, just like the branch of a tree. In this way is formed the horny stem of the Gorgonia, or sea-fan, so long deemed to be of vegetable origin, which, bereft of its polyps, as in our cabinet specimens, is like the branch of a shrub divested of its bark and foliage. The red or noble coral of the Mediterranean,— the *Coral* of the ancients and of the nursery,— is the calcareous axis of another species, stripped of its polyp exterior. Many of the shapes which the coral-forming zoophytes assume are familiarly known.

“ Madrepore shrubs and trees, and the sea-fan and other Gorgoniæ, from the West and East Indies, are common in collections. The hemispheres of *brain-coral* (*Meandrina*), and also of *star-coral* (*Astræa*), are often met with. It is very generally supposed, that these are by far the most frequent, if not the only shapes presented; but, on the contrary, the varieties are extremely numerous, as we have already intimated. Some species grow up in the form of large leaves rolled around one another like an open cabbage, and *cabbage-coral* would be no inapt designation for such species. Another foliated kind consists of leaves more crisped and of more delicate texture, irregularly clustered;— *lettuce-coral* would be a significant name. Each leaf has a surface covered with polyp-flowers, and was formed by the growth and secretion of these polyps. Clustered leaves of the acanthus and oak are at once called to mind by other species; a sprouting asparagus-bed by others. The mushroom is here imitated in very many of its fantastic shapes, and other fungi, with mosses and lichens, add to the variety. The vases of flowers, to which allusion is made on a preceding page, are common about the reefs of the Pacific. They stand on a cylindrical base, which is enveloped in flowers when alive, and consist of a network of branches and branchlets, spreading gracefully from a centre, covered above with crowded sprigs of tinted polyps. The vases in the collections of the Expedition, at Washington, will bear out this description, although but the lifeless coral. The domes of *Astræas* are of perfect symmetry, and often grow to a diameter of ten or twelve feet without a blemish. The ruder hillocks of *Porites* are sometimes twenty feet across. Besides these, we

might describe columns, Hercules' clubs, and various strange shapes which are like nothing but themselves." — pp. 59, 60.

Life, however, is but superficial in these masses. The present generations are building upon the tombs of their fathers. "An Astræa dome, twelve feet in diameter, although solid coral throughout, is alive for only half or three fourths of an inch from the surface"; and in the larger mounds of Porites, a thin living turf of less than half that thickness covers the remains of a myriad ancestry. The founders of the huge Astræas of the Red Sea, coeval at the least with the builders of the oldest pyramids, and the long line of their countless descendants, are thus all preserved together in an ever-increasing ossuary, forming their own mausoleum. The arborescent species are not only lifeless along the axis, but are dead throughout towards the bottom; as in a genealogical tree, only the ultimate ramifications are among the living. But the recent shoots flourish with none the less luxuriance on a lifeless trunk, though death follows, *æquo pulsat pede*, leaving only a narrow interval. Life is but a span, at the best; "the addition of an inch at the apex is death to an inch below."

It is upon this principle of growing ever upward and onward, though perishing below, and upon the durability of the coral mass, protected by an ever active surface, that the power of these apparently insignificant animals to accomplish such great results depends. Themselves often microscopic in size, or but a few lines in height, they would otherwise be limited in their coral-making to a few inches at farthest, and merely incrust the surface upon which they grow, instead of constructing coral-reefs of vast extent, and in various ways bearing a most important part in the physical economy of the world. The extent of this agency, and the whole subject of coral-reefs, upon which it is understood that a large amount of important information has been gathered, our author has reserved for his forthcoming geological report. The physiological points of the subject, however, are admirably presented here. In his brief chapter upon the geographical distribution of zoophytes, Mr. Dana informs us that the work is confided to different species or tribes in different zones or seas, and that each species, just as in the case of land animals and land plants, is generally confined to a comparatively narrow longitudinal range. The

range of the principal corals in depth, also, is remarkably restricted. "Twenty, or perhaps sixteen, fathoms will include very nearly all the species of the Madrepore and *Astræa* tribes," the principal reef-forming corals. A large part of our author's copious introduction — perhaps the most interesting one to the general naturalist — is devoted to showing how the almost infinitely various and singular forms, which different corals or compound zoöphytes present, arise from two or three fundamental modifications in the mode of budding, and the general plan of growth. Taking his cue from the vegetable kingdom, where it is easy to reduce the whole ramification to that particular plan according to which the whole development of the tree has taken place, from the primordial shoot to the ultimate branchlet and the latest leaf, Mr. Dana has ably and clearly shown, that all the forms of coral-structure are reducible to the same fundamental laws of organic growth. He has taught us, not only that the resulting shape of the coral strictly depends on the mode in which the successive polyps have from first to last budded and branched from the parent stem, but also that the actual modes in the zoöphyte are identical with those of vegetable growth. Each principal modification in the plant has its counterpart in the coralline vegetation. There is not merely an analogy between the two, but propagation and growth by budding are truly the same operation in both cases. The *zoöphyte* is an animal which really grows like a plant. But, lest the subject should ramify beyond our narrow limits, we leave it abruptly, copying merely the closing paragraph of one of the author's most attractive chapters.

"There is much to surprise and interest us in tracing out the simple causes of results so remarkable. The small polyp, incapable even of extending its arms without a drop of water to inject them, is enabled, by means of a simple secretion in its texture, in connection with the process of budding, to rise from the rock and spread wide its branches, or erect, with solid masonry, the coral domes, in defiance of the waves that break over them. The microscopic germ of a *Gorgonia* develops a polyp barely visible to the naked eye, which has the power of producing a secretion from its base. The polyp buds, and finally the growing shrub is covered with branches and branchlets, many a mere thread in thickness, which stand and wave unhurt in the agitated waters. The same secretions fix it to its support, and so strongly, that even the rock comes away before the zoöphyte will break

from its attachment. Tens of thousands of polyps cover the branches, like so many flowers, spreading their tinted petals in the genial sunshine, and quiet seas, but withdrawing when the clouds betoken a storm.

“A beautiful provision protects the branching coral-tree — often the work of ages — from being destroyed by the dissolving waters, when exposed, on the death and removal of the polyps. Certain minute incrusting corals — the Bryozoa and Sertularidae, together with Nullipores — make the surface their resting-place, as soon as it is laid bare, and go on spreading and covering the dead trunk, and so prevent the wearing action of the sea. The Madrepore may thus continue to enlarge beyond its adult size ; the Caryophyllia may multiply almost endlessly its cylindrical branchings, although the living animal but tips the extremities of each ; for protection is given at once, when needed, and the polyps die, only to leave the surface to other forms of life, more varied and no less strange.

“Finally, the coral becomes subservient to a still higher purpose than the support of polyps and nullipores. The debris, produced by the waves over a reef, settles into the many crevices among the dead trunks, and fills up the intervals, often large, between the scattered coral-patches ; and, by this combined action of living growth and detritus accumulations, a solid rocky basement is formed, and kept in constant increase. In this way the coral-reef gradually nears the surface, and finally becomes the foundation of one of the fairest of

‘the sea-girt isles,
That, like to rich and various gems, inlay
The unadorned bosom of the deep’;

the coral polyps now yielding place to the flowers and groves of the land, which fulfil their end in promoting the comfort and happiness of man.” — pp. 83, 84.

Here, where our author rises from polyps to men, we may, with a good grace, take leave of him, and pass to the consideration of Mr. Hale’s ethnographical and philological volume. But before doing so, we would briefly but most heartily commend the course which Mr. Dana has thought best to pursue in the principal systematic part of his work, where he has given a revision of all the coral-zoöphytes (the Actinoidea) yet discovered ; rendering it, therefore, a complete manual, and the latest and fullest exponent of what is now known on this hitherto obscure and difficult subject. The propriety, not to say necessity, of this course will be evident

to every one conversant with like subjects, when informed that two hundred and three out of the two hundred and sixty-one Actinoid zoophytes collected in the cruise are here described for the first time ; and that, of the four hundred and eighty-three coral-zoophytes described in the report (the Actiniæ, which make no coral, being excluded from this estimate), only two hundred and fifty-four, or little more than half, are to be found at all in previous works ; while even of those formerly known to naturalists, comparatively few had been examined in a living state. "It is, therefore," to copy the modest statement in the preface, "no presumption on the part of the author, to say that a large amount of new information was obtained, nor a fact which might not have been anticipated, that such information has detected numerous errors in the received systems, or suggested changes of fundamental importance. In making out the report, it was found impossible, in many genera, to describe the newly discovered species without giving new and more definite characters to the old, and the genera themselves sometimes required a modification of their limits, and changes in their associations." A complete revision, therefore, by the light which the researches of the Expedition have thrown upon the whole subject, was probably the most compendious, and, beyond all question, the most desirable and useful plan. This plan Mr. Dana has accordingly adopted, and faithfully executed ; producing a work upon one of the most curious and attractive, though formerly the most obscure and difficult, departments of the animal kingdom, which must long remain the standard authority upon the subject. Nor should it be forgotten, in our estimate of Mr. Dana's labors, that his scientific reputation hitherto has principally rested on his mineralogical writings, that the special field assigned to him was the geology of the Expedition, upon which his reports are still to be made, and that it was only in the course of the voyage, owing to the withdrawal of a zealous member of the scientific corps to whom this department was originally consigned, that the subject of zoophytes fell into his able hands.

The work of Mr. Hale will do credit both to himself and to the country. As this is his first appearance, we believe, in the capacity of an author, it will be proper that we introduce him to our readers. Mr. Hale is the son of Mrs. Sarah J. Hale, well known as a writer and as the editor of a popu-

lar journal. He belonged to the class which was graduated at Harvard University in 1837. His college career was highly distinguished ; he exhibited uncommon powers in the acquisition both of literature and science, and his industry was remarkable. His aptitude for learning languages made him known, even at that early period of his life, to the most distinguished philologists of our country. The late learned president of the American Academy was among his warmest friends. When the Exploring Expedition was fitting out, Mr. Hale, though still an undergraduate, was selected for the place of philologist ; and the result shows that probably a better selection could not have been made. He engaged in the duties to which he was thus honorably appointed, with a zeal and ability which have produced the most valuable results. He has availed himself of all the sources of information previously existing, and has drawn from them whatever came within the range of subjects to which his inquiries were directed. The journals of voyagers, the writings of the missionaries, the researches of philologists into the nature and character of the languages spoken throughout the extensive groups of the Oceanic islands, manuscript vocabularies and grammars, have all been examined, sifted, and combined with the results of personal study and observation. Mr. Hale has thus succeeded in giving a certain classical completeness to his work, which makes it a model for future laborers in the same or in similar fields of research. The style of this volume is marked by rare excellences, and those of the highest order. It is elegant, terse, compact, and business-like, to a remarkable degree. It makes no pretensions to show, assumes no glittering ornaments, runs into no passages of exaggerated eloquence ; at the same time, its literary finish satisfies the demands of a fastidious taste, and possesses the beauty of an exquisite adaptedness to the subjects handled. It is a transparent medium of expression for a richly informed, clear-thinking, straight-forward mind ; it presents the meaning of the writer strongly and directly to the mind of the reader, instructing while it gratifies.

We dwell upon this excellence of Mr. Hale's book with some emphasis, because we are of opinion that the value even of scientific works is materially increased, if the scientific substance is adorned by an appropriate beauty of form ; and we think that in this point of view Mr. Hale deserves especial commendation.

The principal portion of the volume is devoted to the ethnography and philology of Oceanica, or that portion of the globe which lies between the coasts of Asia and America, embracing the continent of Australia or New Holland, the insular masses of the East Indian archipelago, and the innumerable smaller clusters of islands scattered over the Pacific Ocean. This region, called by the French *Océanie*, has been subdivided into five departments, distinguished from each other by their natural features, and by the characters of their inhabitants, and bearing respectively the names of Malaysia, Melanesia, Australia, Micronesia, and Polynesia, all of which were visited and examined, to a greater or less extent, by the scientific corps of the Exploring Expedition. The Northwest Coast of America occupied a portion of Mr. Hale's attention ; and finding at Rio Janeiro some negroes from the South of Africa, he seized the opportunity of investigating the dialects, so far as that could be done, spoken in their part of the country.

The volume thus constructed by Mr. Hale is a beautiful quarto, and the typographical execution of it is worthy of its varied, interesting, and valuable contents. It is divided into two principal departments, ethnography and philology ; the ethnographical portion embraces the first two hundred and twenty-five pages, and the philological, the remaining four hundred and forty-one. In the term ethnography are included the general description of the country, physical characteristics of the inhabitants, religion, mythology, cosmogonies, worship, civil polity, customs and manners, manufactures, migrations, and a variety of other minor but connected topics.* Philology includes whatever relates to mental culture, so far at least as this is connected with language. The several topics are grammar and comparative grammar, including prosody, dictionaries, and vocabularies, poetical composition, music, and the like. This arrangement is sound and rational. Ethnography forms an excellent introduction to philology ; it is a sort of basis for the intellectual superstructure.

This part of the work, however, does not contain so much

* Mr. Hale certainly gives a very extensive meaning to this word, *ethnography*, and thereby departs widely from the usage of late years, which confines the signification of the term to "an account of the filiation of the different races of human beings."

new and original matter as the philological. It is, nevertheless, of great interest, and wrought out with great ability. Many of the materials bearing upon this part of the subject already existed, scattered over the works of previous writers. The great merit of Mr. Hale here is the admirable judgment with which he has combined these materials into a consistent whole, adding such particulars as his own observation enabled him to supply, and thus presenting a gallery of ethnographical pictures, of the highest importance, and distinguished by a classical finish and beauty of execution. They show a remarkable acuteness and tact in discerning the characteristic peculiarities of the numerous tribes included in his survey, and facility in their delineation. The many curious analogies between barbarian institutions and those of the most refined nations are readily seized and clearly pointed out. The systems of government existing among the Oceanic nations are skilfully developed ; their traditions, superstitions, religious rites, and cosmogonies, not merely well described, but analyzed and philosophically explained. The legal antiquary will find the principles of the feudal tenure amply illustrated by the rules which regulated the land tenures in the Sandwich Islands before the adoption of their present written constitution. On the other hand, the sturdy enemies of law and order, the champions of absolute equality, will discover that they have been anticipated and even excelled by the Australians ; that they are at the best but awkward imitators, *servum pecus*, when compared with the philosophers of that continent, who in politics have no government, and in their language have no terms to express the ideas of command and obedience.

The Shakers will be pleased to know that one of their leading principles is practically enforced by the Australian moralists upon the young men, who, while unmarried, are forbidden to approach, or to speak to, a female. The dietetic sages, especially the disciples of Mr. Graham, will be gratified to be informed, that the same modest and shy young gentlemen are not allowed to eat fish or eggs, or the emu, or any of the finer kinds of opossum and kangaroo ; though, to be sure, these restrictions are gradually removed as the subjects of them get on in life, and when they have passed the period of middle age, they are entirely unrestrained in the choice of food. Mr. Hale throws in a qualifying reflection here, which we quote for the benefit of the old heads among

our peptic philosophers. "Whether one purpose of this law be to accustom the young men to a hardy and simple style of living may be doubted ; but its prime object and its result certainly are to prevent the young men from possessing themselves, by their superior strength and agility, of all the more desirable articles of food, and leaving only the refuse to the elders." The chivalrous practice of the duello is in full force among this people ; and all their arrangements are so consonant to the high sense of natural justice which exists in countries where this mode of settling private quarrels prevails, that we must cite a portion of them for the benefit of our Southern friends.

"The parties meet in presence of their kindred and friends, who form a circle round them as witnesses and umpires. They stand up opposite one another, armed each with a club about two feet long. The injured person has the right of striking the first blow, to receive which the other is obliged to extend his head forward, with the side turned partially upwards. The blow is inflicted with a force commensurate with the vindictive feeling of the avenger. A white man, with an ordinary cranium, would be killed outright ; but owing to the great thickness of their skulls, this seldom happens with the natives. The challenged party now takes his turn to strike, and the other is obliged to place himself in the same posture of convenience. In this way the combat is continued, with alternate buffets, until one of them is stunned, or the expiation is deemed satisfactory."

Now, here is the very beau ideal of single combat, or, to speak learnedly, *monomachy* ; and it is perfectly adapted to the requirements of "white men" whose conduct is moulded by the principles of the "code of honor" ; for they, like "the natives," are distinguished by "the great thickness of their skulls."

But we have not space to dwell at length on the various topics suggested by the ethnography of this interesting region. A few words on the migrations of the Oceanic tribes must close what we have to say on this branch of the subject. Mr. Hale remarks,—"As the examination of the customs and idioms of the Polynesian tribes leaves no room to doubt that they form, in fact, but a single nation, and as the similarity of their dialects warrants the supposition that no great length of time has elapsed since their dispersion, we are naturally led to inquire whether it may not be possible, by the compar-

ison of their idioms and traditions, and by other indications, to determine, with at least some degree of probability, the original point from which their separation took place, and the manner in which it was effected." By this point our author means, in the present inquiry, the island or group in the Pacific which was first inhabited, and which bore to the rest the relation of the mother country to the colonies.

Mr. Hale pursues the investigation with great care and ingenuity. He examines the grammar and vocabulary of the various dialects, and finds many forms in those of the western groups which are entirely wanting in the eastern tongues ; others, which are complete in the former, are found defective in the latter, and perverted from what seems evidently their original meaning. A similar examination of the religious characteristics shows that in the west a simple mythology and spiritual worship exist, which are perverted, as we advance towards the east, into a debasing and cruel idolatry. The fashion of tattooing also, which, in Samoa and Tonga, is intended to answer the purposes of decency, has degenerated elsewhere into a mode of ornament.

At one of the Hervey Islands there is a tradition among the inhabitants that their ancestor ascended from a region beneath, called *Aavaiki* ; a similar tradition prevails among the Marquesans, who give to the region the name of *Havaiki*. This name is evidently connected with the *Hawai'i* of the Sandwich Islands ; and all these terms are the precise forms which the name of the largest of the Navigator Islands (*Savai'i*) would assume in the different dialects. Mr. Hale thinks, that, by following this clue, the different tribes of Polynesia may all be referred back to their original seat. In fact, the dialectical changes which this name would undergo, according to the rules laid down in the comparative grammar, are : —

" 1. Original form,	Savaiki.
2. Samoan dialect,	Savai'i.
3. Tahitian,	Hawai'i.
4. Sandwich Island,	Hawai'i.
5. Rarotongan and Mangarevan,	Aavaiki.
6. Nukuhivan,	Havaiki.
7. New Zealand,	Hawaiki."

This name, therefore, our author considers, with strong reason, to be the key-word of the Polynesian migrations.

Mr. Hale pursues the investigation among the various groups, collecting the incidental and collateral facts, combining the traditions and myths, examining genealogical lists preserved in the memories of the inhabitants, some of which run back through a series of more than two thousand years, illustrating tradition by the significance of names of places, the names of the months, of the winds, of the numerals, and arrives at the conclusion that all the principal tribes of Polynesia may be traced back to the Samoan and Tongan groups. An interesting question here arises, How far the supposed emigration of the first settlers in these groups from some point in the Malaisian archipelago may be confirmed by the information we now possess. The evidence here is not so decisive, on account of our ignorance of the dialects spoken in the eastern part of this archipelago. From a variety of considerations of considerable weight, it seems probable, that the primitive seat of these tribes is Bouro, or Booro, the easternmost island inhabited by the yellow Malaisian race, in the East Indian archipelago. The interesting point in these inquiries is the result, conclusively established, that the progress of emigration was from west to east, and not in the contrary direction. Combining this result with the known course of the migrations of the Indo-Germanic races, the theory that the primitive seat of the human race was in the interior of Asia seems to receive important and interesting confirmation.

The ethnography of Northwestern America we must pass over, in order to say a few words upon the philological part of Mr. Hale's great work, — merely alluding, by the way, to the hypothesis, that the hordes which at different periods overran the Mexican plateau made their way through this territory ; a conjecture countenanced by two facts : first, that such a progress is now going on, particularly in the interior plains ; secondly, that the tribes speaking allied languages are dispersed over this territory in a direction from north to south.

The most valuable and elaborate portion of the philological division is the "Comparative Grammar of the Polynesian Dialects." The reasons for bringing the materials for elucidating the structure of the Polynesian dialects into this form are, that

"By this mode the various idioms are brought together in such a way, that the points of resemblance and distinction among them all are perceived at once. The changes, also, which the general

language undergoes, in passing from one group to another, are thus made apparent, and the principles which govern these changes being once discerned will prove, it is believed, of no little importance to the science of philology. It happens, moreover, in many cases, that what is doubtful and obscure in one dialect is elucidated by a comparison with others,—the mere juxtaposition being often sufficient for this purpose. Finally, by this form, as the repetition of the same rules and explanations for different dialects is avoided, the whole is brought into a much smaller space than would otherwise be possible, with greater convenience of reference, and no loss of clearness."

In drawing up this grammar, Mr. Hale has made use, in addition to the materials collected by himself, of the translations made by the missionaries into seven of the principal dialects,—namely, the Samoan, Tongan, New Zealand, Rarotongan, Mangarevan, Tahitian, and Hawaiian; of manuscript grammars and vocabularies furnished by the missionaries in some of the islands; and of printed works relating to four of the dialects. Several other sources of information are indicated. Of the merits of this grammar, as a philosophical analysis and explanation of the structure of the Polynesian dialects, it would be difficult to speak in exaggerated terms. In the distribution of topics, in the lucid arrangement of the parts, in the clearness of the statement of principles, in the ingenuity of the etymological deductions, the work will bear a favorable comparison with the best philosophical grammars by the scholars of Europe. As a contribution to general philology, it will stand in the foremost rank, unless the foolish economy of the government in limiting the number of copies published should unfortunately operate to exclude its valuable contents from the general fund of philological knowledge, and to defraud Mr. Hale of the reputation which is justly his due.

We had intended to present a brief view of the peculiarities of the Polynesian dialects; but we must content ourselves with selecting two or three. The language of ceremony among the Samoans is remarkable for its formal politeness. They have particular expressions of salutation and compliment, according to the time of day, as morning, noon, and evening; many terms in their common idiom are considered improper to be addressed to persons of rank, and their place is supplied by other words of the same signification, which are never used but on such occasions; they have

different words for the different grades of chiefs. Thus, the salutation to a common man, on entering a house, is *ua mai*, you have come ; to a *tula-fale*, or householder, it is *ua alala mai* ; to a low chief, *ua maliu mai* ; to a high chief, *ua susu mai* ; to the sovereign, *ua afio mai*. This principle is carried out to an extraordinary length. To *eat* and to *sleep*, for instance, are expressed by different words, according as the acts are performed by a landholder, an inferior chief, or a high chief.

A more remarkable peculiarity, called by Mr. Hale *ceremonial neology*, prevails among the Tahitians. It is the singular mode of displaying their reverence towards their king, by a custom which they term *te pi*. The words which form a part or the whole of the sovereign's name, or that of one of his near relatives, are dropped in the common language, and new ones invented to supply their place ; and as proper names in Polynesia are significant, and each chief has usually more than one, the language undergoes considerable changes from this cause. The changes, however, are temporary ; as at the death of the king or chief, the original words are restored to popular use. Vancouver, as quoted by Mr. Hale, observes, "that, at the accession of Otu, which took place between the visit of Cook and his own, no less than forty or fifty of the most common words, which occur in conversation, had been entirely changed." But for the rule by which the old terms are revived, on the death of the person to whose name they belonged, the vocabulary of the language would, in a few centuries, be entirely changed.

The Polynesian grammar is followed by a thoroughly prepared lexicon, in which the primitive or radical form of each word, or that which is considered to be such, is first given in large type, and then the variations in form and meaning which occur in the different dialects are added, together with the most important derivatives. An English and Polynesian vocabulary is next given. Then we have an essay on the dialect of Fakaaso and Vaitupu, with a brief vocabulary of the same, and a grammar and vocabulary of the Vitian language. The Vitians or Feejeeans, Mr. Hale informs us, pay more attention than any of their Polynesian neighbours to poetical composition. This people present some quite remarkable points of resemblance to the ancient Greeks — a very curious illustration of the analogies between the extremes

of barbarism and civilization. Their dances are accompanied by songs in recitative, to which the motions of the dancers correspond, precisely like the choral and orchestric exhibitions of the Greeks. Song and dance are inseparable, and festivals are signalized by the production of a *meke*, or dance, of which both the movements and the words are composed for the occasion. There are persons who devote themselves, like the *aoiðol*, to this species of composition, and who sometimes acquire reputation and wealth by this exercise of their genius, "twenty *tambua* [the native currency of whale's teeth] being sometimes given for a single song and dance. As a person with forty or fifty of these teeth is considered wealthy, and for eight or ten a ship may be supplied with provisions for a cruise, it is evident that the Feejeeans affix no slight value to the works of their composers."

Besides the restraints of tune and dance to which the Vitian poet must submit, he is fettered by a complicated and peculiar system of rhythm and rhyme. The most common measure in Vitian songs consists of three dactyles and a trochee, which may be technically called logaœdic dactyles ; but, by another remarkable coincidence with the metrical principles of the Greeks and Romans, a spondee may take the place of either of the dactyles, as in the line

ān tīkō | mai nā | tambū tā | ngānē.

One variation, however, unknown to the Greeks and Romans, is permitted in the case of reduplicated words, which are considered as containing only as many syllables as the simple words. We commend this rhythmical anomaly to Professors Beck and Felton, as a new example of what they would denominate *arrhythmia*.

But the difficulties which the Vitian poet has to encounter do not end here.

"There is, in addition to this, a peculiar manner of rhyming, which must require in the composer a great command of words, as well as skill in disposing them. The rule is as follows :— those vowels which are contained in the last two syllables of the first line of a stanza, must be found in the same order in the last two syllables of every succeeding line ; and the greater the number of lines which are thus made to conform, the better is the poetry esteemed."

This is rather consonance than rhyme, and could only pre-

vail, to any great extent, in languages distinguished for the predominance of the vowel sounds. Vitian poetry, it will be seen, thus combines the peculiarities of the ancient classical versification, and of the minstrelsy of the romance languages, in the days of the Courts of Love.

The remainder of the volume is occupied with grammars and vocabularies of the less important dialects of Oceanica, including, of course, Australia. Then we have a very curious account of the languages of Northwestern America, in regard to which the singular fact is stated, that the languages north of the Columbia river are remarkable

"for their extraordinary harshness, which in some is so great as almost to surpass belief. The Chinooks, Chikailish, and Killamuks, appear actually to labor in speaking,—an illusion which proceeds, no doubt, from the effect produced on the ear of the listener by the harsh elements with which their languages abound, as well as by the generally rough and dissonant style of pronunciation. The *x* is, in these tongues, a somewhat deeper guttural than the Spanish *jota*. The *g* is an extraordinary sound, resembling the hawking noise produced by an effort to expel phlegm from the throat. A similar element (as we are assured on good authority) in the Quicchuan or Peruvian language is called by the Spanish grammarians the *cc castañuelas*, and is compared to the sound made in cracking nuts with the teeth,—from which, of course, we can only infer its extreme harshness. *Tχl* is a combination uttered by forcing out the breath at the side of the mouth, between the tongue and the palate. The vocabularies, and the remarks upon them, will exhibit some other peculiarities of these languages. They are all indistinct, as well as harsh. The same element in the Tshinuk and other tongues is heard at one time as a *v*, at another as a *b*, and again as an *m*,—the latter being probably the most accurate representation. So the *n* and *d* are in several undistinguishable, and we were constantly in doubt whether certain short vowels should be written or omitted.

"The southern languages are, on the other hand, no less distinguished for softness and harmony. The gutturals are found in two or three, into which they seem to have been introduced by communication with the northern tribes. The rest want this class of letters, and have, in their place, the labial *f*, the liquid *r*, and the nasal *ñ*, all of which are unknown in the former. Difficult combinations of consonants rarely occur, and the many vowels make the pronunciation clear and sonorous. There is, however, a good deal of variety in this respect, some of the lan-

guages, as the Lutuami, Saste, and Palaihnik, being smooth and agreeable to the ear, while the Shoshoni and Kalapuya, though soft, are nasal and indistinct." — pp. 533, 534.

We venture humbly to suggest to Mr. Buchanan whether this philological line would not be a good basis on which to settle the Oregon boundary. One of the most curious chapters is that which contains an outline of the Jargon, or Trade language, of Oregon. Here we detect nature in the very act of creating a new language, by fusing together the various materials existing in distinct dialects, and remoulding them upon new principles, and for the purpose of supplying new wants. The elements of this dialect are the Nootka, English, Tshinuk, and French ; together with a supply of words formed by the *onomatopæia*, or principle of representing sense by sound. As the language is spoken by Tshinuks, Englishmen, and Frenchmen, it rejects all sounds which cannot readily be pronounced by all three ; and this constitutes the point of peculiar interest in the phonology of the language. If we had room, it would be amusing to copy a few specimens of this Jargon. If left to itself, it would in time, doubtless, unfold into a copious and regular language, with its distinctive principles of syntax and rhythm ; but it will doubtless disappear, as a civilized population advances and occupies the country with permanent settlements. The volume ends with a brief account of the languages of Patagonia and of Southern Africa.

We have given only a cursory review of the interesting and important contents of Mr. Hale's work ; but we think our readers, and others whose attention may be called to it, will agree with us in pronouncing it a most valuable contribution to ethnography and philology, and, as such, highly honorable to the scholarship of our country.